

CLAIMS:

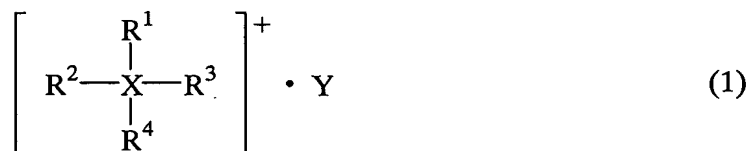
1. A nonaqueous electrolyte characterized by containing:  
an ionic liquid which has general formula (1) below and is  
5 liquid at not higher than 50° C



wherein R<sup>1</sup> to R<sup>4</sup> are each independently an alkyl group of 1  
to 5 carbons or an alkoxyalkyl group of the formula  
R'-O-(CH<sub>2</sub>)<sub>n</sub>- (R' being methyl or ethyl, and the letter n  
10 being an integer from 1 to 4), and any two from among R<sup>1</sup>, R<sup>2</sup>,  
R<sup>3</sup> and R<sup>4</sup> may together form a ring, with the proviso that at  
least one of R<sup>1</sup> to R<sup>4</sup> is an alkoxyalkyl group of the above  
formula,

X is a nitrogen atom or a phosphorus atom, and  
15 Y is a monovalent anion; and  
an ion-conductive polymer.

2. A nonaqueous electrolyte which is characterized in  
that it is obtained by curing a composition containing:  
20 an ionic liquid which has general formula (1) below and is  
liquid at not higher than 50° C



wherein R<sup>1</sup> to R<sup>4</sup> are each independently an alkyl group of 1  
to 5 carbons or an alkoxyalkyl group of the formula  
25 R'-O-(CH<sub>2</sub>)<sub>n</sub>- (R' being methyl or ethyl, and the letter n  
being an integer from 1 to 4), and any two from among R<sup>1</sup>, R<sup>2</sup>,  
R<sup>3</sup> and R<sup>4</sup> may together form a ring, with the proviso that at  
least one of R<sup>1</sup> to R<sup>4</sup> is an alkoxyalkyl group of the above  
formula,

X is a nitrogen atom or a phosphorus atom, and  
Y is a monovalent anion;  
a compound having a reactive double bond on the  
molecule; and

5 an ion-conductive polymer.

3. The nonaqueous electrolyte of claim 1 or 2 which is  
characterized by containing a lithium salt.

10 4. The nonaqueous electrolyte of claim 3 which is  
characterized in that the lithium salt is  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ ,  
 $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$ ,  $\text{LiCF}_3\text{SO}_3$  or  $\text{LiCF}_3\text{CO}_2$ .

15 5. The nonaqueous electrolyte of any one of claims 1 to 4  
which is characterized in that the ion-conductive polymer is  
a noncrystalline polymer.

6. The nonaqueous electrolyte of any one of claims 1 to 5  
which is characterized in that the ion-conductive polymer has  
20 a relative permittivity at 25°C and 1 MHz of 5 to 50.

7. The nonaqueous electrolyte of any one of claims 1 to 6  
which is characterized in that the ion-conductive polymer is  
a thermoplastic polyurethane resin.

25 8. The nonaqueous electrolyte of any one of claims 1 to 6  
which is characterized in that the ion-conductive polymer is  
a hydroxyalkyl polysaccharide or a hydroxyalkyl  
polysaccharide derivative.

30 9. The nonaqueous electrolyte of any one of claims 1 to 6  
which is characterized in that the ion-conductive polymer is  
a polymeric compound having an average degree of  
polymerization of at least 20 and containing polyvinyl  
35 alcohol groups of general formula (2) below



wherein n is a number from 20 to 10,000, some or all of the hydroxyl groups on the polyvinyl alcohol units being substituted with oxyalkylene-bearing units having an average molar substitution of at least 0.3.

5

10. The nonaqueous electrolyte of any one of claims 1 to 6 which is characterized in that the ion-conductive polymer is a polymeric compound having an average degree of polymerization of at least 20 and containing polyvinyl alcohol units of general formula (2) below



wherein n is a number from 20 to 10,000, some or all of the hydroxyl groups on the polyvinyl alcohol units being substituted with cyano-substituted monovalent hydrocarbon groups.

15

11. The nonaqueous electrolyte of any one of claims 1 to 6 which is characterized in that the ion-conductive polymer is a polymeric compound having units of formula (3) and units of formula (4)

20



wherein at least 10% of the end groups on the molecular chain are capped with one or more groups selected from among halogen atoms, substituted or unsubstituted monovalent hydrocarbon groups,  $\text{R}^5\text{CO-}$  groups ( $\text{R}^5$  being a substituted or unsubstituted monovalent hydrocarbon group),  $\text{R}^5\text{Si}_3\text{-}$  groups ( $\text{R}^5$  being the same as above), amino groups, alkylamino groups,  $\text{H(OR}^6\text{)}_m\text{-}$  groups ( $\text{R}^6$  being an alkylene group of 2 to 4 carbons,

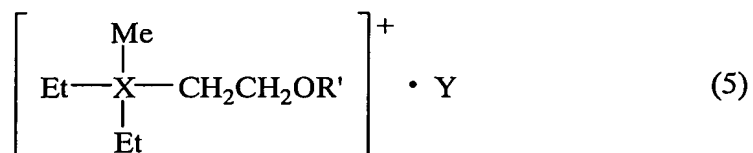
25

and m being an integer from 1 to 100) and phosphorus atom-containing groups.

12. The nonaqueous electrolyte of any one of claims 1 to 5 11 which is characterized in that the ionic liquid is liquid at not higher than 25°C.

13. The nonaqueous electrolyte of any one of claims 1 to 10 12 which is characterized in that X is a nitrogen atom, R' is methyl, and n is 2.

14. The nonaqueous electrolyte of any one of claims 1 to 12 which is characterized in that the ionic liquid has general formula (5) below



15

wherein R' is methyl or ethyl, X is a nitrogen atom or a phosphorus atom, Y is a monovalent anion, Me stands for methyl and Et stands for ethyl.

20 15. The nonaqueous electrolyte of any one of claims 1 to 14 which is characterized in that Y is  $\text{BF}_4^-$ ,  $\text{PF}_6^-$ ,  $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ ,  $\text{CF}_3\text{SO}_3^-$  or  $\text{CF}_3\text{CO}_2^-$ .

25 16. An electrical double-layer capacitor comprising a pair of polarizable electrodes, a separator between the polarizable electrodes and a nonaqueous electrolyte,

which electrical double-layer capacitor is characterized in that the nonaqueous electrolyte is a nonaqueous electrolyte according to any one of claims 1 to 15.

30

17. A nonaqueous electrolyte secondary cell comprising a positive electrode which contains a lithium-containing double oxide, a negative electrode which contains a carbonaceous

material capable of lithium ion insertion and extraction or contains metallic lithium, a separator between the positive and negative electrodes, and a nonaqueous electrolyte;

5       which nonaqueous secondary cell is characterized in that the nonaqueous electrolyte is a nonaqueous electrolyte according to any one of claims 1 to 15.